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Aviation Research - 1963

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[4] Aviation research seemed to settle down into a new pattern in 1963. Several signs indicated that the doldrums of the late 1950s and early 1960s were coming to an end. Foremost was the realization that the aircraft of the 1950s cannot compete with the aircraft of the 1960s, either commercially or militarily. Even more significant, it was becoming increasingly obvious to high-level military planners that the aircraft in service in 1963 could not do the job required in the 1970s. However, since it takes from 6 to 8 years to design, develop, and procure a new aircraft in useful quantities, it was clear that new hardware should be authorized as soon as possible to meet the requirements of the 1970s. A potential roadblock of unknown magnitude, though, was the decline and near-fatal reduction of aeronautical research in the first five years of the space age.

William Littlewood, Vice President of American Airlines for equipment research, in May called attention to the fact that "the United States is woefully deficient in funds and efforts to solve the essential research problems, to gain the basic knowledge, to develop the potentials of atmospheric flight, as to safety, comfort, and efficiency, to compete successfully and for long with the foreign advances in this field."

Later in the year, on August 9, Senator Mike Monroney, a member of the knowledgeable Senate Committee on Commerce and Chairman of that Committee's Subcommittee on Aviation, again

pointed up to the inadequacy of the National Aeronautics and Space Administration's aeronautical research when he said that a bureaucracy in the United States "apparently has forgotten the importance of aviation to our economy, to our national prestige, and to our military strength .... Before we have completely and totally fallen behind in aviation research and aeronautical technology, I would request that the National Aeronautics and Space Administration, with the concurrence of the Committee on Aeronautical and Space Sciences, authorize within the limitations of this bill the transfer of funds required to meet the needs of aviation."

A completely different viewpoint was expressed the same day in the Senate, however, when Clinton Anderson, Chairman of the Senate Committee on Aeronautical and Space Sciences, answered Senator Monroney's plea for increased emphasis on aeronautical research with the more-or-less standard reply, "There is no reason to believe that the aeronautics program has been lost somewhere in the gigantic wake of manned lunar efforts. NASA will continue to play its accustomed important role in this important area."

Even so, a serious blow to aeronautical research in the United States came when Charles H. Zimmerman, Director of NASA Aeronautical Research, resigned to accept a position with the Army. This marked the second year in a row that the Director of Aeronautical Research for NASA had resigned--John Stack in 1962 after less than a year in the job, and Zimmerman after a little more than a year. At press time a replacement for Zimmerman had not been chosen.

However, all was not dreary in the aviation research picture. There were some bright spots in the United States--and even more in Europe--notably in vertical and short take-off and landing (V/STOL) research. Supersonic and hypersonic research in the United States was another bright spot, due mainly to the X-15 research airplane program. The supersonic transport (SST) was probably the brightest spot in aviation research in 1963--and it will remain the focal point for a large portion of the aeronautical research effort for many years to come.

The 1,450-mile-per-hour "Concorde" being designed by a British-French consortium of British Aircraft Corporation and Sud-Aviation passed a major milestone on June 4, 1963, when a United States airline--Pan American World Airways--placed an order for six. This was followed in short order by an order from Continental Air Lines for three Concordes. Cost will range from $13 million to $15 million each. With the orders placed by British Overseas Airways Corporation (BOAC) and Air France, also on June 4, the Concorde books showed 21 aircraft on order.

The first flight of the 100-passenger aluminum Concorde prototype is scheduled for mid-1966. The first production aircraft will fly in 1968, with scheduled passenger service to begin in 1970. Two versions will be built, a 3,250 mile version (250,000 pounds) by the British Aircraft Corporation and a 2,500 mile version (200,000 pounds) by Sud Aviation. Each will be powered by four 33,000-pound-thrust Bristol Siddeley Olympus 593 engines.

Fundamental flight research in support of the Concorde program was underway in 1963. The Hunting H.126 (jet-flap research) which first flew on March 26, the Handley Page H.P. 115 (slender delta wing research), and the Bristol Type 221, scheduled to fly in late 1963, were providing design data for the Concorde. In addition, a tremendous level of ground-based research effort was being directed toward solving the design and development problems of the Concorde. Research laboratories in England and France were working at top speed, in an attempt to expedite an already ambitious time schedule proposed for the airplane.

In the United States, the supersonic transport effort got into high gear in 1963. After many months of preliminary work by industry and government experts, Vice President Johnson and a cabinet-level committee in May recommended that the United States proceed with the design and construction of a supersonic transport. This report was sent to President Kennedy on June 1, four days before a speech at the Air Force Academy. The President during the speech announced his decision to initiate the United States supersonic transport program.

The President, on June 14, sent a letter to Congress stating that the national aviation objectives of the United States required a program to support the development of a commercial supersonic transport. As stated by President Kennedy, the United States transport must be one which is "safe for the passenger, economically sound for the world's airlines, and whose operating performance is superior to that of any comparable

aircraft." He continued, "I am convinced that our national interest requires that we move ahead in this vital area with a sound program which will develop this aircraft in an efficient manner."

As envisioned by the President, the Supersonic Transport program might cost as much as $1 billion, with the government putting up 75-percent of the cost and private industry contributing the remaining 25 percent. A minor setback came when the airframe manufacturers and two of the three possible engine manufacturers intially balked at the cost-sharing scheme proposed by the President. However, later in the year North American Aviation, Lockheed, and Boeing, and Pratt and Whitney, General Electric, and Curtiss-Wright indicated they would participate in the design competition for the supersonic transport. Douglas, General Dynamics, and McDonnell declined to take a major role in the competition.

In his message to Congress, Mr. Kennedy gave the overall responsibility for the program to the Federal Aviation Agency, in keeping with the Federal Aviation Act of 1958. Gordon M. Bain, Deputy Administrator for SST Development, was appointed to head the Federal Aviation Agency effort.

The request for proposals sent to perspective airframe and engine manufacturers by the Federal Aviation Agency in mid-August included these objectives for the United States SST:

Range	4,000 statute miles
Capacity	125-160 passengers plus 5,000 pounds of cargo and mail
Cruising speed	Mach number of 2.2 or faster (roughly 1,500 miles per hour)

Noise	not to exceed noise levels of current long-range jet transports
Sonic boom over-pressure levels on the ground	during acceleration to cruise conditions: 2.0 pounds per square foot; during cruise: 1.5 pounds per square foot
Runway length	must be capable of operating from today's major jet airports

An initial appropriation of $60 million to get the program off the ground was included in the Federal Aviation Agency FY 1964 budget request.

NASA in a three-day technical conference in September, summarized SST research in the United States. Several major findings of the NASA-sponsored research were:

--The maximum allowable pressure rise due to sonic boom will be a controlling factor in the gross weight of a supersonic transport design

--The aircraft will have a gross weight roughly one-third greater than present subsonic jets.

--Titanium, used as a structural material, yields a much lighter airplane than one constructed of stainless steel.

--Reserve fuel requirements will be extremely important in the supersonic transport. Under some conditions, reserve fuel weight could be more than the payload. It appears possible that advanced traffic-control techniques under development may ease the reserve fuel requirement.

More research is needed on general aerodynamic efficiency, and on low-speed stability and control. There is a requirement for an improved engineering understanding of the use of titanium

as a structural metal. Additional work is also indicated in the area of airworthiness and operating considerations to provide a sharper definition of the criteria which should be used in advanced transport aircraft designs.

The next step in the SST program in the United States will be the submission of bids in response to the FAA's request for proposals. These are due by January 15, 1964. If the responses prove to be practical, and a clearly superior airframe and engine have been proposed, the FAA will choose the manufacturers with the best proposals by May 1, 1964, to proceed with the development of the aircraft. If the proposals are not entirely acceptable, two airframe and two engine manufacturers will be selected to continue the SST development program for a 12-month period. One airframe manufacturer and one engine manufacturer would then be selected by May 1965 to complete the development of the SST. The entire effort would be directed toward a first-flight date sometime in 1967. Passenger service would begin in 1970. Cost will be about $23 million each, about 50-percent more than the Concorde.

However, as President Kennedy pointed out, "If at any point in the development program, it appears that the aircraft will not be economically sound ... we must be prepared to postpone, terminate, or substantially redirect this program."

While the United States, England, and France were pushing programs to fly people faster, Russia was toying with an idea for flying people cheaper--and flying more people. One proposal centered around a seaplane designed to carry 2,000

passengers at speeds of about 500 miles per hour. Operating cost for this 1,000-metric-ton airplane would be about one-sixth the cost of a modern subsonic jet transport, on a passenger-mile basis, and about one-tenth the cost of the world's most modern ocean liner. On a normal utilization basis, an airplae of this size could carry as many passengers in a year as 20 ordinary jet transports or six ocean liners. According to the Russians, such a seaplane could be built using 1963 information and techniques.

Russia, however, was not overlooking the prestige and propaganda value of the SST. They will probably convert a four-engine Mach number 1.8 "Bounder" bomber for use as a commercial supersonic transport. This 300,000-pound airplane--first shown publicly in 1961--could be in airline service by late 1966 or early 1967. As with most Russian transports, however, it will probably be uneconomical to operate on competitive airline routes. A Mach number 2.8 SST hinted at by Russia would fly at an even later date than the converted "Bounder."

In the <u>hypersonic research</u> area, 1963 saw the decision to rebuild and modify the extensively-damaged X-15-2, to give it a Mach 8 capability. This increased performance will be obtained by adding huge external propellant tanks to the basic configuration.

Ablative coatings will be used to keep structural temperatures below the 1,200°F design limit. Although the modification will increase the top speed by about 1,300 miles

per hour, maximum altitude capability will be the same as for the unmodified airplane. As a matter of fact, the design altitude has been set at 100,000 feet for the modified airplane.

Rollout of the Mach-number-8 X-15-2 is planned for March 1964. About $1\frac{1}{2}$ to 2 months will be required for instrumentation and preflight tests prior to the first flight. If no problems are encountered, the first Mach 8 airplane flight could be made before the end of 1964.

What use is Mach 8? FAA Administrator N. E. Halaby gave a concise answer during the Connecticut General Aviation Symposium on May 16: "We must face the prospect of the hypersonic transport--speed in the ranges of Mach 8, and 8,000 miles. NASA and some of the bolder airframe and engine private manufacturers for the United States must look ahead at these problems, if the United States is to stay ahead." Fortunately for the United States, the NASA and the manufacturers were considering this opportunity for the future, in 1963--for a technically and operationally practical hypersonic air transport (TOP HAT).

One of the greatest values of the increased X-15-2 capability is to provide a means of testing large air-breathing propulsion components and systems, using hydrogen as the fuel. Propulsion has been the pacing item since before the Wright brothers flight and it likely will continue to remain so. In general, propulsion has not advanced as fast as the state-of-the-art would permit. If the Mach 8 X-15 can provide sufficient

research information in the next several years, the Mach 8 TOP HAT will be expedited. If Mach 8 propulsion research must depend on ground test facilities or an occasional rocket-boosted test, the TOP HAT might be delayed several decades.

Other uses for the Mach 8 X-15 would be to obtain data on high temperature structures and in the field of hypersonic aerodynamics.

The X-15-1 and X-15-3 aircraft continued to provide invaluable data in 1963. Aerodynamic and structural heating, stability and control at high speeds and high angles of attack, aeromedical, and many other studies were conducted. As a by-product, two new unofficial altitude records were set: 347,800 feet on July 19 and 354,000 feet on August 22, both by Joseph A. Walker, Chief Research Pilot at the NASA Flight Research Center, Edwards, California.

In the V/STOL (vertical/short take-off and landing) field, aviation research is attracting wide attention and sound financial support. During 1963, a few of the vehicles under various stages of development were:

France	Germany
Dassault Balzac V-001	Bolkow Bo46 Rotorcraft
Breguet 941	Siat Super STOL 311A
Mirage III V	VJ-101C
	Dornier Do. 32
	Dornier Do. 31

Great Britain	United States
Hawker P. 1127 (U.S. XV-6A)	Lockheed XH-51A rigid rotor helicopter

Great Britain (cont.)

Hawker P. 1154

Whitworth Gloster 681

United States (cont.)

GE/Ryan XV-5A

Curtiss-Wright X-19A

BELL X-22A

Vought-Hiller-Ryan XC-142A

Lockheed XV-4A Hummingbird

Sikorsky S-64 flying crane helicopter

The large number of vehicles tends to indicate that the V/STOL field is just now beginning to be exploited, and that there are a nearly infinite number of things V/STOL aircraft can do. However, they can not do all of these things well nor can they necessarily do them better than some other type of vehicle. The problem is to find the right vehicle for each job. This type of research--finding the right vehicle--will continue in the V/STOL field for many years to come.

Primary areas for V/STOL research were in noise reduction, initial cost and maintenance cost, and flying and handling qualities. Extensive research must be done on making V/STOL aircraft "all-weather" aircraft, too. Effort was being directed toward the solution of all of these problems.

The rigid-rotor concept may provide the long-awaited breakthrough. Inherent stability, simplicity, and low vibration levels were claimed for the Lockheed XH-51A rigid-rotor helicopter, the first to employ this concept. The Bell Sioux Scout, in a specialized field, shows what can be done for attack helicopters using advanced thinking with state-of-the-art

hardware.

Other areas which may require a vast amount of research in order to develop advanced hardware for the military services are long-endurance aircraft; an all-jet cargo airplane for large, bulky cargo (Air Force CX-4 concept), possibly employing a variation of the laminar-flow-control used on the X-21A, capable of carrying over 100,000 pounds, three times the load of today's aircraft, up to 5,000 miles at 500-mile-per-hour speeds; a 10-ton VTOL transport (Air Force CX-6 concept); a Mach 3 to Mach 5 top-speed "high-low" missile-carrying bomber which would fly at high speed, at high altitude, then descend to tree-top level and fly the remainder of the distance to the target subsonically; a new strategic reconnaissance aircraft, smaller than the XB-70 but larger and faster than the U-2; and an effective counter-insurgency (COIN) airplane which is quite different from the cheap truboprop-powered fiberglass airplane originally planned.

In the civil field, the hue and cry was still heard for a DC-3 replacement, the small, short-haul, subsidy-saving transport--"the SSSST," according to FAA Administrator Halaby. The Association of Local Transport Airlines stated that the ideal "new DC-3" would cruise faster than 300 miles per hour, have two turbine engines, and carry 18 passengers plus 1,000 pounds of cargo up to 500 miles, but still make money on flights as short as 80 miles. All this for $500,000 or less.

Most aircraft advertised as DC-3 replacements to date

have been too big, too fast, and too expensive. To get the program moving, the FAA planned to ask for Presidential support for initiation of a design competition. The idea was received enthusiastically by many members of Congress. This will probably become a sizeable program in 1964.

In 1963 it appeared that the pendulum was beginning--slowly--to swing back toward increased emphasis on aeronautical research.

A summary of aeronautical research for 1963 would not be complete without respectful comment on the death of Dr. Theodore von Karman in Aachen, Germany, on May 7 at the age of 81. Writing of von Karman, one of his friends put down; "As his field of effort has grown, and as its results have been felt throughout the world of this time, so may we see the real worth of Theodore von Karman."

He was kind. He was wise. He was interesting. He was interested in people. He had a great sense of humor.

He will be missed.

James A. Martin

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